after being subjected to the environmental treatments specified in § 84.307; and

(3) One unit will be tested, in the condition in which it was received from the applicant, by a human subject on a treadmill.

(b) Except as provided under paragraph (c) of this section, the performance test will apply a repeating cycle of work rates, according to the sequence and requirements specified in Table 3, until the oxygen supply of the unit is exhausted.

(c) Testing of CCERs with less than 50 liters of capacity, as determined by the capacity testing under § 84.304, will require the submission of additional test units to fully apply the work-rate test sequence and requirements specified in Table 3. The testing of each individual unit will complete the cycle specified in Table 3 until the breathing supply of the initial test unit is exhausted. This initial test unit will then be replaced by a second unit, which will continue the test cycle, beginning at the work rate in the cycle at which the initial unit was exhausted, and completing the full period specified in Table 3 for that work rate before proceeding to the subsequent work rate, if any, specified in Table 3. Each initial testing unit will be replaced as many times as necessary to complete the cycle, not to exceed two replacement units per initial test unit.

(d) The performance test will begin with two exhalations into the unit at the specified ventilation rate and then follow the manufacturer's instructions to determine the design's susceptibility to hypoxia upon initial donning.

TABLE 3—PERFORMANCE TEST REQUIREMENTS

Work-rate test sequence	Duration per cycle (in minutes)	VO_2 (L/min)	VCO_2 (L/min)	Ve (L/min)	RF (breaths/min)
1. Peak	5	3.00	3.20	65.0	25
2. High	15	2.00	1.80	44.0	20
3. Low	10	0.50	0.40	20.0	12

VO_2 = volume of oxygen consumed per minute; VCO_2 = volume of carbon dioxide produced per minute.
Ve = ventilation rate in liters of air per minute; RF = respiratory frequency.

§ 84.306 Wearability test requirements.

(a) NIOSH will conduct the wearability test on a total of three of the units submitted for approval. Three human subjects (two males and one female), one subject per unit, will conduct the test. The three subjects will range in height and weight as follows: One subject of height ≥174 cm and weight ≥90 kg; one subject of either 163 cm ≤height <174 cm, regardless of weight, or 72 kg ≥weight <90 kg, regardless of height; and one subject of height <163 cm and weight <72 kg. All units tested must meet all conditions specified in this section to receive approval.

(b) NIOSH will evaluate the ease and speed with which users can don the CCER, as follows:

(1) Each test subject will be provided with manufacturer instructions, and must be able to don the CCER correctly, isolating the lungs within 30 seconds;[1] and

(2) A CCER must not include any design, construction, or material characteristic that can be anticipated or demonstrated, under plausible conditions, to hinder the user in the correct and timely donning of the CCER.

(c) NIOSH will continuously monitor CCER use by each test subject during the activities specified in Table 4 to evaluate the ability of the CCER to provide an adequate and uninterrupted breathing supply, including but not limited to the requirements of § 84.303(b), without harming or hindering a user. NIOSH will not approve a CCER if the use of any unit during these activities indicates any potential for the CCER to harm or hinder the user or to fail to provide an adequate

[1] This time limit does not apply to any additional steps that might be required after the lungs are protected to adjust the unit for wear.

and uninterrupted breathing supply to the user during reasonably anticipated conditions and activities of an escape.

TABLE 4—WEARABILITY TEST REQUIREMENTS

Activity	Minimum duration
Sitting	1 minute.
Stooped walking	1 minute.
Crawling	1 minute.
Lying on left side	1 minute.
Lying on right side	1 minute.
Lying on back	1 minute.
Bending over to touch toes	1 minute.
Turning head from side to side	1 minute (at least 10 times).
Nodding head up and down	1 minute (at least 10 times).
Climbing steps or a laddermill	1 minute (1 step/second).
Carrying 50-lb bag on treadmill at 5 kph	1 minute.
Lifting 20-lb weight from floor to an upright position	1 minute (at least 10 times).
Running on treadmill at 10 kph	1 minute.

§ 84.307 Environmental treatments.

(a) Four units submitted for approval will be tested for capacity and performance, pursuant to the requirements of §§ 84.303 through 84.305, after exposure to environmental treatments simulating extreme storage temperatures, shock, and vibration.

(b) The units will be stored for 16 hours at a temperature of −45 °C and for 48 hours at a temperature of 71 °C. Units will be returned to room temperature between high and low temperature treatments. The maximum rate of change for thermal loading shall not exceed 3 °C per minute and constant temperatures shall be maintained within ±2 °C.

(c) The units, in the casing in which they are deployed for individual use, will be subjected to physical shock according to the following procedure:

(1) The unit will be dropped six times from a height of 1 meter onto a concrete surface; and

(2) Each drop will test a different orientation of the unit, with two drops along each of its three major axes (top to bottom, left to right, and front to back).

(d) The units will be subjected to vibration according to the following procedure:

(1) The unit will be firmly secured to a shaker table, which will be vibrated with motion applied along a single axis for 180 minutes;

(2) The unit will be vibrated one axis at a time along each of three axes for a total of 9 hours; and

(3) The vibration frequency regimen applied to each axis will be cyclical, repeating the sequence and specifications provided in Table 5 every 20 minutes.

TABLE 5—VIBRATION TEST SEQUENCE

Sequence	Frequency (Hertz)	Acceleration g (±peak)
1	5–92	2.5
2	92–500	3.5
3	500–2000	1.5

§ 84.308 Additional testing.

(a) NIOSH will conduct additional tests, as indicated below, on one or more of the units submitted for approval. Each unit tested must meet the conditions specified in these tests for the CCER to receive approval.

(b) NIOSH will perform safety hazard tests on any CCER that stores more than 200 liters of oxygen or that stores compressed oxygen at pressures exceeding 3,000 psi. The applicant must submit 15 units in addition to the 21–23 units required for testing under §§ 84.304 through 84.307. These units will be evaluated for fire and explosion hazards using the tests specified in RI 9333, pages 4–18; RI 8890, pages 6–62; and PRC Report No. 4294, pages 18–62.

(c) NIOSH will perform the following tests on the eye protection (gas-tight goggles or escape hood lens) of one or more units of every CCER submitted for approval: